DOCUMENT RESUME

ED 288 828 SP 029 560

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TITLE A Research-Based In-Service Program for Helping Teachers Ask Questions Which Facilitate Development of Higher Order Thinking.
PUB DATE Nov 87
NOTE 14p.; Paper presented at the Annual Conference of the National Council of States on Inservice Education (12th, San Diego, CA, November 20-24, 1987).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Abstract Reasoning; Academic Achievement; *Cognitive Development; *Critical Thinking; *Inservice Teacher Education; Program Development; *Questioning Techniques; Secondary Education
IDENTIFIERS *Higher Order Thinking

ABSTRACT

An inservice model was developed to assist teachers in asking students the kinds of questions that facilitate higher order thinking. Higher order thinking involves problem identification and definition, hypothesizing, collecting, analyzing and synthesizing data, and formulating conclusions that upon application will prove valid. Based on this conception, an inservice model was developed to assist teachers in asking students the kinds of questions that facilitate higher order thinking. The model consisted of training teachers who, after 10 to 12 weeks of concentrated teaching and evaluation procedures for a unit of study related to a comprehensive structure of a discipline, may initiate a network of district inservice programs as district staff developers in a specific discipline. Utilized with social science content and secondary school teachers and students, the inservice training increased student achievement in critical thinking and was significantly more successful with persons demonstrating flexibility and a preference for abstract reasoning. Adapted for art teachers at five grade levels and teaching the same concepts in essentially the same lesson, post training results showed significantly greater proportions of class time devoted to teacher inquiry questions and appropriate student responses indicating higher order thinking. (Author/CB)

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A RESEARCH-BASED IN-SERVICE PROGRAM FOR HELPING TEACHERS ASK QUESTIONS WHICH FACILITATE DEVELOPMENT OF HIGHER ORDER THINKING

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Paper presented at the
National Council of States on Inservice Education
12th Annual National Conference
November 20-24, 1987
San Diego, California

SP 029 560

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A RESEARCH-BASED IN-SERVICE PROGRAM FOR HELPING TEACHERS ASK QUESTIONS WHICH FACILITATE DEVELOPMENT OF HIGHER ORDER COGNITIVE SKILLS

Higher order thinking involves the ability to identify and define problems; construct hypotheses; collect, analyze, evaluate and synthesize data; and formulate conclusions that, upon application, will prove valid. The development of higher order cognitive abilities has been referred to as problem solving, reflective thinking, and / or critical thinking at various times during this past quarter-century.

Since 1983, "A Nation At Risk; The Imperative for Educational Reform" and more recent recommendations of several blue ribbon panels have brought higher order thinking into the limelight. Higher order thinking was of primary interest immediately following Sputnik and led to the development of modern math, science and social studies in the early 1960's. It was subsequently displaced by the humanistic movement of the late sixties.The "accountability"/ "back to basics" movement of the seventies returned attention to more academic outcomes of education and was motivated by concern over students' testing patterns. Based on the decline in SAT and ACT scores approximately 15 years after Sputnik, it can be inferred that fewer students were being prepared to function beyond the recall level of thinking. Today, education is still attempting to reverse this trend.

An important variable in developing higher order thinking is the instructional methodology employed. A review of the literature in the mid and late sixties involving experiments in the teaching of problem solving and/or reflective thinking revealed no reports of significant differences in achievement of those taught by the traditional methodology and the inquiry

oriented, problem solving method (Cousins,1962; Cox,1961; Massiales,1961, Elsmere, 1961). It was from an examination of the experimental data,and instruments used to collect data, that inadequacies of the instruments being used to gather evidence of the differences between the two methods of teaching were exposed (Armstrong,1970). The tests used were tests of achievement rather than problem solving. In addition, many of the studies took place in either middle class public schools or laboratory schools and the students had topped out on the pretest leaving little room for showing differences in achievement on the post tests. Most importantly, examination of the transcribed tapes of the studies cited indicated an absence of the kind of sequential questioning that would promote formulating principles and generalizations representing higher order thinking.

This indicated a need to appropriately teach for and measure higher order thinking. Considering the Piaget-described development from thinking in the concrete to using formal abstract logic, teachers should provide instructional stimuli appropriate to the students' conceptual levels and ask sequential questions (Gagne',1965) to facilitate higher order, more abstract thinking. A study with junior high Social Studies students tested this theory (Armstrong, 1970).A questioning strategy was developed to encourage inductive reasoning utilizing concrete stimuli in order that the students would develop a visualization of the concepts being taught. Following the achievement of the relevant concepts, the questioning strategy led students to formulate principles or generalizations related to the topic of study.

This research demonstrated that sequential hierarchical questioning strategies reflecting Gagne's types of learning could modify the intellectual skills and abilities of eighth grade students. Based on analysis of data

gathered in the study, students made no significant increases in achievement on a teacher made test or the standardized achievement test. This was compatible with previous research results. However, experiencing learning by the hierarchical questioning strategy significantly increased scores in critical thinking as measured by the Watson-Glaser Test of Critical Thinking. In addition, in students' rankings of preferred subjects, Social Studies changed from an average pre-experiment ranking of lowest to a post-experiment ranking of second from highest position.

From this research an approach to in-service training for teachers who desired to facilitate higher order thinking in their students was developed.

The Value of Higher Order Thinking

The development of higher order thinking skills is appropriate in our society beyond the very basic argument of developing students' intellectual capacity. Our society has evolved from the industrial stage of economic development to an information processing society that values effective communication skills including higher order abstract reasoning. Thus, the need to retool the professional staff of schools is evident.

The task of retraining education professionals with course work and/or the typical in-service program of four half-days per school year was often ineffective. Therefore, an improved way was needed to develop teachers who could ask questions that challenged students to higher order thinking.

The Model

The challenge of an improved inservice approach resulted in a cost-effective method of updating an entire staff in their ability to facilitate students' higher order thinking. It does so without producing the high anxiety climate so frequently associated with requests for change.

Following consultations with district office administration personnel, volunteers are requested from the instructional faculty. Experience has indicated that self-confident, achievement-oriented, flexible thinkers are most apt to apply. When volunteers exceed three teachers per discipline, then three are selected on the basis of their flexibility in thinking as measured by the Gough-Sanford Rigidity Scale (Rokeach,1960) and their learning preference style as indicated by the Kolb Learning Style Preference Scale (1971). On successful completion of their training, these teachers become district-wide trainers of their colleagues in their discipline.

The duration of in-sevice program is 10 to 12 weeks if conducted as a four-hour meeting once per week. If extra stipends are not available for Saturday meetings or if Saturday committments prohibit meeting on that day, Wednesday afternoon (Noon to 4 pm) usually is a suitable compromise. A certificate indicating a teacher's status as a district staff developer is awarded at the completion of the program.

The in-servicing is directed by a teacher trainer in three phases as seen on Figure 1, utilizing outside discipline specialists as needed by the teachers. Phase one orients the teachers in three sessions. Phase two involves application, analysis and modification in sessions four to ten. Phase three,sessions eleven and twelve, prepare to expand district-wide.

Insert Figure 1 about here.

Phase one

Phase one provides the teachers with a theoretical and philosophical background for the need for higher order thinking and questioning as the methodology appropriate to developing it. Teachers are asked to bring an audio taped recording of a lesson they have taught to the first session to establish baseline data and practice with the coding form introduced. Using

lessons from their current curriculum, teachers revise a lesson to incorporate attention to levels of intellectual skills as identified and defined by Gagne' (1965), namely, discriminations, concepts, principles, and higher order principles or generalizations. The final task in phase one initiates revising one curriculum unit. Of primary importance in this task is the identification of a generalization(s) that is the basis of the structure of the unit and is a component of the structure of the discipline. From the generalization(s), principles and concepts are identified that must be understood by the student.

Phase two

Five sessions of Phase two are devoted to a cyclical procedure of teacher planning, teaching,recording,coding,analyzing and modifying lessons under the tutelage of the in-service director (teacher-trainer). The teacher selects relevant stimuli and plans questions designed to facilitate students' concept formation. The instructor plans sequences of questions designed to lead students to higher order thinking-- to meaningfully relate and synthesize concepts into principles and abstract general statements.

When teaching the lesson plan, the teacher records the classroom interaction for subsequent coding of the question types to permit analysis of how closely the application matched the teacher's intent. Question planning of lessons to follow should continually reflect refinements based on what the teacher observed about his/her teaching via the analysis of the coding. The teacher must listen closely on order to make a decision as to the outcome of learning encouraged by the semantics of a question asked; but this is the procedure that helps a teacher hear not what was intended, but rather what was verbalized.

The culmination of phase two includes the presentation and discussion of the results of the cyclical planning and modification process. The final written revisions of a unit with detailed lesson plans and questioning strategy are made available to fellow teachers of that discipline district-wide. In addition, plans are made for participating teachers to assume the responsibility of staff developers and implement the model they experienced in their own schools. Procedures are suggested for participant selection, setting up opportunities for modeling the teacher questioning strategy, approaches to coaching others in questioning strategies and addressing typical problems that might arise.

Phase three

Phase three is an optional component based on the degree of expertise and confidence of the new staff developers. It assists in making the smooth transition to a district operated staff development system. That extended staff development in-service plan may be ongoing depending on the size of the district, faculty turnover and committment to the goal of developing higher order thinking.

Recent Research Findings

The inservice model described was implemented in four public school districts. Three large school districts started the program in late August with pretesting of students in the first week of September,and the posttesting in mid January. The fourth school district started in September with their pretesting and finished the following May. This district was rather small and the goal was to train the entire teaching staff over a one year period rather than to develop teacher trainers.

The entire initial population of volunteer teachers in the three large

school districts completed the training. Forty percent of the teachers in the smaller school district completed the training. Those who dropped out scored high in the Gough-Sanford Rigidity Scale (Rokeach, 1960).

As in the in-service model described, the teachers in all four districts coded audio tapes of their teaching before and after instruction in questioning strategies. The training for all four schools was conducted similarly and included the coding of tapes by the teacher, other teachers from the same discipline, and the in-service director. When comparing the first and final taped lessons, teachers asked more informational questions, concept questions, and questions asking students to formulate principles and/or generalizations in the final lessons.

Students experiencing the questioning strategy for higher order thinking showed gains on the appropriate form of the Watson-Glaser Critical Thinking Appraisal and standardized achievement tests. Test scores of academic achievement and critical thinking of students taught with the sequential questioning strategy averaged about 23% higher than the students whose teachers did not finish the program or who, in the three large school districts, had not participated.

Some interesting spin-offs of this in-service approach have been informally reported by the participants. For example, one of the school systems discovered a significant difference in student self concept during the school year as measured by the Piers-Harris Self-Concept Inventory and /or the Personal Orientation Inventory. Another school system reported an increased sharing of ideas and instructional materials by teachers. A third school system reported that teachers who had been told that their contracts would not be renewed were offered contracts following their completion of the in-service program due to their improved classroom performance.

Variations of the Model

Variations in the model for developing the ability to ask questions to encourage higher order thinking grow out of varying contexts and the nature of disciplines. Contexts can vary for the training sessions and may be incorporated into graduate level courses on instructional strategies, condensed into a weekend workshop format, pursued as independent study by individuals, or spread over a year. Longer intervals between sessions allow teachers to introduce a lesson that involves students in higher order thinking as appropriate to the content and objective. Teachers of special area, such as art, find this arrangement more acceptable since the amount of time spent in student application (especially, high school production components) spaces opportunities for introduction of new lessons.

Finally,the mode of instruction with which teachers and students have been comfortable may lengthen the time that it takes to incorporate questioning strategies for higher order thinking into the modus operandi. The traditions of some disciplines may lend themselves more obviously to questioning for higher order thinking that involves increased student verbalization.

Results of a Variation of the Model:Inquiry in Art Production

Art education, currently undergoing a major move for reconceptualization, is one of those areas of study that has not emphasized verbalization of ideas in the past. It is most appropriate to help art teachers to involve students in talking about art, and the Inquiry in Art structure for teacher questions addresses this need in connection with the production components of art education (Armstrong, 1986). This structure is based heavily on Gagne's intellectual skills with some added categories for teacher questions based

on artists' descriptions of their creative process behaviors. In an independent study variation of the inservice model explained in this article, research was conducted with six art teachers to try to increase the types of questions which would facilitate higher order thinking in their students (Armstrong, 1987). A filmstrip/audio tape was the major instructional tool for teacher volunteers wanting to learn the inquiry approach to art production. Each art teacher taught the same lesson (concepts designated) to two comparable groups (grade levels two,four,six,eight and two high school introduction to art courses) first by their normal teaching method and then, after training with the filmstrip/audio tape, using the Inquiry in Art questioning strategy.

This research incorporated a systematic timed analysis and evaluation of the types of teacher questions asked before and after training as recorded on videotape. Classroom interaction was coded to determine the actual question type and amount of time devoted to each category of classroom interaction as well as the level of student verbal response to the teacher. At all five grade levels, there were significantly greater proportions of post-training (inquiry) class time devoted to verbal interaction, teacher questions, teacher inquiry questions, student verbalization and appropriate student responses to inquiry questions which included questions aimed at eliciting higher order thinking. There was less time involved in actual production, but the achievement in amount completed and quality were comparable to the group taking more time in the production components. Students were able to operate in a more self-directed manner when they did begin their actual art production.

These findings indicated that across personal teaching styles and grade

levels, and with minimal training, art teachers could modify their teaching to facilitate students' higher order thinking. In addition, student enthusiasm, self-direction, and correct application of the concepts learned could be observed in their art products and in the verbal observations they made about their work in class discussions.

Summary

Inservice training in questioning strategies designed to encourage higher order thinking can be effective and economical. The key lies in the following critical elements:

1. a long term committment;
2. relating specific instructional objectives to a comprehensive view of one's discipline;
3. application of theory and conscientious evaluation of the results with opportunities for modifications of future trials based on previous feedback;and
4. a network of trained staff developers directing the inservice training process by modeling, coaching, and encouraging other teachers.

Several qualities recommend this model for improving instruction. The model addresses a current and future societal need. Preparation of students to operate in the arena awaiting them means developing comfort and ability in higher order thinking. The content of the inservice model described is theoretically sound and enables teachers to improve classroom instruction. It is designed to have a ripple effect, utilizing school personnel after the initial training of a cadre of teachers for roles as future district staff development directors. The model has proven successful in effecting teacher questioning capabilities and student performance in higher order thinking in a variety of contexts and across disciplines.

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Figure 1 # IN SERVICE STAFF DEVELOPMENT TIMELINE

SELECT TWO OR THREE DISTRICT TRAINERS PER DISCIPLINE FROM VOLUNTEERS

Example: ILLINOIS: 12 teachers representing Social sciences, Math, Fine arts, Physical education, Science, Language arts.

Assistance from:

* Structure of disciplines developed in the 1960's
* Paid consultants with discipline expertise
* Previous education in liberal arts

TRAINING SCHEDULE: FOUR HOURS /DAY, ONE DAY/WEEK

Week	Topics/Tasks:
1	Theoretical backgrounds Teachers record a lesson (#1)
2	Questioning strategies. Coding.
3	Modification of an existing curriculum unit
4	Develop lesson #2 using questioning strategy. Teach, record, code and analyze #2. Critique analyses of lessons #2.
5	Select hierarchical content and develop questioning strategies for lesson #3 Teach, record, code and analyze #3.
6	Select hierarchical content and develop questioning strategies for lesson #4 Teach, record, code and analyze #4
7	Complete development of unit and refinement of lesson plans.
8	Practice questioning strategy with self-directed coding and analysis of lesson #5 ...plus Critique analyses of tapes.
9	Presentation and discussion of completed units and lesson plans
10	Procedures for staff developers: Selection of participants, modeling, coaching, and problems.
11	Introduce new teachers to the process in combination with development of semester-long curriculum guides (1/discipline)
12	

IMMEDIATE GOAL: CERTIFIED TEAM OF DISTRICT "X" STAFF DEVELOPERS IN COGNITIVE SKILL DEVELOPMENT

END GOAL: CHANGE AND MODIFICATION OVER A PERIOD OF 2-4 YEARS RESULTING IN STUDENT HIGHER ORDER COGNITIVE SKILL DEVELOPMENT